Review Questions

Choose the letter that represents the BEST response.

Assumptions of the Labor Demand Model

1. When a firm faces competition in the labor market
   a. the wage the firm pays can be treated as constant.
   b. the firm can buy as much or as little labor as it wants at a going wage rate.
   c. the firm’s marginal expense of labor equals the wage rate.
   d. all of the above.

2. When a firm faces competition in the product market
   a. the product price the firm receives can be treated as a given.
   b. the firm can sell as much or as little of its product as it wants at a going price.
   c. the firm’s marginal revenue equals the product price.
   d. all of the above.

3. As the firm increases its employment, it is typically assumed that the marginal product of labor will eventually decline. An economic reason for why this occurs is that
   a. the law of diminishing returns applies.
   b. an increase in employment causes the wage to fall and this, in turn, causes workers to exert less effort.
   c. at some point, additional units of labor bring about a smaller change in total output than previous units did.
   d. Each additional worker has a smaller share of capital with which to work.

Short-Run Demand for Labor

4. A firm will maximize its profits in the short run when
   a. the difference between \( MR_L \) and \( ME_L \) is as large as possible.
   b. \( MR_L \) equals \( ME_L \), or the difference between them is as small as possible.
   c. the money wage workers receive \( (W) \) equals the marginal product.
   d. the marginal revenue product \( (MRP_L) \) equals the marginal cost \( (MC) \).

5. The marginal revenue product curve is the firm’s short-run demand curve for labor provided
   a. the firm faces competition in the labor market.
   b. the firm faces competition in the output market.
   c. \( MRP_L = MR \times MP_L \).
   d. both a and b.
6. For a firm to survive in a competitive environment
   a. it must follow the $MRP_L = ME_L$ rule.
   b. it must act as if it is following the $MRP_L = ME_L$ rule.
   c. it must be able to verbalize the conditions for profit maximization.
   d. it must be able to accurately measure the marginal revenue product of its workers.

7. Figure 3-2 shows the short-run labor demand curves (expressed as a function of the real wage) for
   the three individual firms that hire this type of labor. At a real wage of 10, the quantity associated
   with the market demand curve would be
   a. 15 units of labor.
   b. 17.5 units of labor.
   c. 20 units of labor.
   d. 35 units of labor.

Long-Run Demand for Labor

8. Assume the price of labor ($W$) equals $10 and the price of capital ($C$) equals $36. Also suppose that
   at the current mix of labor and capital, $MPL = 5$ and $MPK = 12$. Using the rule for cost minimization,
   which of the following correctly describes what the firm should do to its labor and capital mix?
   a. Increase $L$ and decrease $K$.
   b. Decrease $L$ and increase $K$.
   c. Increase both $L$ and $K$.
   d. $L$ and $K$ should not change.

9. Suppose the price of capital falls. If the scale effect associated with the price change dominates the
   substitution effect,
   a. the quantity of labor demanded will increase.
   b. the quantity of labor demanded will decrease.
   c. labor and capital can be called gross substitutes.
   d. both b and c.
10. Suppose the price of capital falls. If capital and labor are used in fixed proportions in the production process,
   a. the substitution effect is zero.
   b. the scale effect will dominate the substitution effect.
   c. labor and capital will be gross complements.
   d. all of the above.

11. If the price of capital rises and the long-run demand for labor curve shifts right, one can infer that
   a. the scale effect dominated the substitution effect.
   b. the substitution effect dominated the scale effect.
   c. labor and capital are gross substitutes.
   d. both b and c.

Who Bears the Burden of the Payroll Tax?

In answering Questions 15–18, refer to Figure 3-3. The curve labeled $D_0$ represents the short-run market demand before the payroll tax is imposed, while $D_1$ represents the curve after a tax (in real terms) of $X$ per employee has been imposed on the firm. The curve labeled $S$ is the market supply curve for labor. The wage on the vertical axis represents the real wage ($W/P$) employees actually receive.

12. What is the amount of the tax?
   a. $X = 0.5$
   b. $X = 1$
   c. $X = 2$
   d. $X = 4$

13. The percentage of the tax the workers bear in the form of lower wages is
   a. 10%.
   b. 25%.
   c. 50%.
   d. 100%.
14. What has been the effect of the payroll tax on the employment level?
   a. Employment has fallen by 1.
   b. Employment has fallen by 2.
   c. Employment has risen by 1.
   d. There has been no change in employment.

15. What percentage of the tax would the worker bear in the form of lower wages if the supply curve (S) were perfectly vertical (i.e., quantity supplied was extremely insensitive to changes in the wage)?
   a. 0%
   b. 25%
   c. 50%
   d. 100%

A Graphical Approach to Labor Demand (Appendix 3A)

In answering Questions 19–21, refer to Figure 3-4, which shows the cost-minimizing combination of L and K for producing 100 units of output when \( W = $16 \) and \( C = $25 \).

![Figure 3-4](image)

16. At the cost-minimizing combination of L and K, the ratio of MPL to MPK, the marginal rate of technical substitution (MRTS), equals
   a. 0.64.
   b. 1.5625.
   c. 2.
   d. 2.25.

17. The total cost level associated with the optimal combination of L and K is
   a. $4,000.
   b. $4,100.
   c. $4,405.
   d. $4,750.
18. If the price of capital were to rise to $40, which of the following statements would be true?
   a. If the firm wanted to stay at the same cost level, the output of the firm would have to fall.
   b. If the firm wanted to stay at the same output level, the total cost would have to rise.
   c. If the firm stayed at the same output level, it would adjust its input mix to use less capital and more labor.
   d. All of the above.

## Problems

### The Short-Run Demand for Labor

19. Recall that the marginal revenue product of labor (MRPL) is defined as $MR \times MPL$.

19a. Using the definitions of marginal revenue and marginal product of labor, prove that $MR \times MPL$ equals the marginal revenue associated with an additional unit of labor ($MR_L$).

19b. Explain why the $MRPL$ curve slopes downward.

20. The demand for labor is called a derived demand since without the demand for the final product, there would be no demand for labor. Using the data associated with Figure 3-1 in the Summary section, show what would happen to the demand for labor when each of the following changes takes place.

20a. Suppose the demand for the product increased in such a way that the product price rose to $4. Find the equation for the firm’s new demand curve for labor. What would be the new optimal level of labor assuming $W$ stays at $10$?

20b. In the short run, by definition, the capital stock is fixed. Show what would happen to the demand for labor if the capital stock were fixed at 20 units instead. Find the equation for the firm’s new demand curve for labor. What would be the new optimal level of labor, assuming $W$ stays at $10$?

20c. Finally, show what would happen to the firm’s demand for labor if labor became more productive so that the production function could now be represented by the formula

$$Q = 2KL - 0.025KL^2,$$

which would make the marginal product expression at $K = 10$

$$MPL = 20 - 0.5L.$$

Find the equation for the firm’s new demand curve for labor. What would be the new optimal level of labor assuming $W$ stays at $10$?

21. The demand for labor can be expressed in terms of real or nominal (money) wages. Figure 3-1 in the Summary section is expressed in terms of the nominal wage.

21a. Redraw Figure 3-1 expressing the demand for labor in terms of the real wage.
21b. What curve plays the role of the firm’s demand curve for labor when the real wage is plotted on the vertical axis?

22. Suppose the following equations represent the demand for two firms demanding a particular type of labor. The curves are expressed as functions of the real wage.

\[
\text{Firm 1: } L_1 = 50 - (W/P).
\]

\[
\text{Firm 2: } L_2 = 25 - 0.5(W/P).
\]

22a. Plot the two curves on the same axes and then construct the market demand.

22b. Find the equation for the market demand curve.

**The Long-Run Demand for Labor**

23. Suppose the firm currently employs 500 workers and 100 units of capital and that the following relationship holds.

\[
\frac{W}{MP_L} = \frac{16}{4} = 4 \quad \frac{C}{MP_K} = \frac{50}{10} = 5.
\]

Prove that the firm is not at an equilibrium mix of labor and capital by showing there is a window of opportunity for it to reduce its total cost.

*24. Use the data in the Summary section Example problem to answer the following questions.

*24a. Find the substitution and scale effects associated with an increase in the wage from $4 to $9 assuming the firm faces a market demand given by the equation \( P = 56 - 2Q \).

24b. Are labor and capital gross substitutes or gross complements? Will the demand for capital shift right or left as the wage increases?

*25. Use the data in the Summary section Example problem to answer the following questions.

*25a. Find the substitution and scale effects associated with an increase in the price of capital from $16 to $36. Assume the wage rate is constant at $4.

25b. Are labor and capital gross substitutes or gross complements? Will the labor demand curve shift left or right as the price of capital increases?

**A Graphical Approach to Labor Demand (Appendix 3A)**

26. Consider the isoquants shown in Figure 3-5. Assume the level of capital is fixed at 4 units in the short run.

26a. Find the marginal product of labor associated with a movement from point \( a \) to point \( b \). Do the same for a movement from point \( b \) to point \( c \).
26b. Is the diagram consistent with the notion of a diminishing marginal product of labor? If so, does it help to explain why the marginal product declines?

27. Figure 3-6 depicts a situation where the firm must use capital and labor in a fixed one-to-one proportion. For example, if the firm uses 70 units of capital and 70 units of labor, it will be able to produce 70 units of output. However, if it adds another unit of capital without adding another unit of labor, output would remain at 70 units. Suppose that originally the price of labor is $5, the price of capital is $10, and the optimal level of output is 70.

The cost-minimizing point is where the firm uses 70 units of labor and 70 units of capital (point a). Now suppose the price of capital rises to $20 and the firm responds by moving to point b.

27a. Find the substitution effect on labor and capital of the capital price change.

27b. Find the scale effect on labor and capital of the capital price change.

27c. Are labor and capital gross substitutes or gross complements?

27d. Has the firm’s total cost level increased or decreased after the change in the price of capital?